THE EFFECT OF KNOWLEDGE TYPES ON HYBRID CARS PREFERENCES*

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ABSTRACT

Choices on products comes from various factors and knowledge is one of them. When choosing a product consumers are using either subjective knowledge or objective knowledge. And some of them want to use a combination the knowledge. In this paper, we investigate the effect of knowledge types on Hybrid Car (HCs) attributes preferences. The Choice Modelling technique is used where the six attributes chosen for the study were driving range; hybrid battery warranty period; government incentives; CO_2 emission level; source of energy; and engine's sound. A total of 242 respondents in Kedah and Perlis were interviewed but only 197 were usable for analysis. The results show that the respondents who acquired subjective knowledge are more preferred on the HCs attributes compared to those who have objective knowledge. The results provide some useful information on policy implication in marketing innovation.

Keywords: Hybrid Cars, Choice Modelling, Attributes

Introduction

Choices on products comes from various factors and knowledge is one of them. When choosing a product consumers are using either subjective knowledge or objective knowledge. And some of them want to use a combination the knowledge. The subjective knowledge is referring to knowledge that consumers obtained directly from the experience when consuming the products.

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On the other hand the objective knowledge is the one that he/she acquired indirectly mainly *via* reading information on the products such as brochure or watching their advertisement.

Knowledge input are produced by past consumption of goods, education level and other human capital inputs. Consumers will use the acquired knowledge in the process of consuming activities (Ratchford, 2001). In addition, knowledge that were obtained from the past experience has their impacts on the preferences for future consumption (Park, Mothersbaugh, & Feick, 1994). However, what is lacking in the literature is the interrelation between preferences of newly introduced product and knowledge types.

Eco-friendly cars or Hybrid Cars (HCs) is one of the examples newly introduced products that receive various views. For example, some consumers would argue that the cars are not really environmental friendly. But for others the cars are actually environmental friendly. Why this happened? Due to the fact that the HCs are great new technology and rarely on road, many consumers have no self-experience and communicable experience. Usually, consumers rely on available reading materials such as brochures or articles on magazine. Such situation is true particularly in developing countries such as Malaysia. Since the cars employs current technology, consumers who are not familiar with the technology may have different opinion in terms of its benefits and costs. Undoubtedly, the opinion come from their knowledge. Hence we may say that their type of knowledge in HCs may affect their preferences on HCs attributes.

We conducted a face to face consumer survey on HCs preferences. In the study, Choice Modelling (CM) technique is used to investigate whether consumers who have different types of knowledge (i.e. subjective and objective) will have different preferences on the HCs attributes. The results show that the respondents who acquired subjective knowledge are more preferred on the HCs attributes compared to those who have objective knowledge. Though in promoting environmentally friendly vehicle is undertaken on subsidization policy (Sallee, 2011) such as tax

exemption on HCs, the effectiveness of the policy depends on the consumer knowledge on HCs. Based on the study's finding, we suggest that the government should not only subsidize the production or tax exemption but to consider the marketing innovation as well. In this context, marketing innovation is referring to a process of cutting the transaction cost for consumers in getting knowledge on HCs. This study sheds light to the recent discussion on in several issues such as a promoting environmentally friendly product, and consumer behavior towards ecology.

The rest of the paper is organized as follows. Section 2 describes the CM. Section 3 discusses the methodology. Section 4 presents and discusses the empirical results. Finally, Section 5 concludes.

Choice Modelling (CM) Specification

Two underpinning theories in CE are theory of value and random utility theory (Lancaster, 1966; McFadden, 1973). The random utility can be illustrated as follows. In a simple example that only consists of two choices, *i* or *j*, the behavioral model is therefore, choose good *i* if and only if $U_{in} > U_{ij}$ where$U_{in/j} = V_{in/j} + e_{in/j}$. In random utility terms, the probability that consumer *n* chooses good *i* (P_{in}) is shown in equation (1).

$$P_{in} = P_r(U_{in} > U_{jn}) \\ = P_r(V_{in} + e_{in} > V_{jn} + e_{jn}) \\ = P_r(e_{jn} - e_{in} < V_{in} - V_{jn}) \quad (1)$$

An assumption on distribution error terms, e_n, will determine the probability of choosing choice *i*. Usually the error terms are assumed to be distributed independently and identically (iid) with a Gumbell (or Type 1 extreme-value) (Swait, 2007) as shown in equation (2):

$$f(e) = \exp(-\exp(-\mu e))$$

(2)

Based on equation (2), the selection of choice *i* can be expressed in terms of a logistic function where the error terms are assumed to be distributed as Gumbell, with a scale factor μ (McFadden, 1973). If three or more choices are considered then the logistic distribution can be expressed as a Conditional Logit (CL) model. Since the scale factor cannot be identified due to its value is confounded with the vector of utility parameters (Swait & Louviere, 1993), hence μ is assumed equal to 1. Therefore, the probability of choosing choice *i* in the CL model is shown in (3):

$$P_{in} = \frac{\exp(V_{in})}{\sum_{j \in J_n} \exp(V_{jn})}$$

(3)

Study Design

The attributes used in the study were selected based on reviews on the related published HCs articles. After identified them we conducted three focus group meetings to determine their suitability to be used in the study. The number of participants in each meeting was 7-8 persons as suggested by Morgan (1997). Based on the meetings the suggested attributes were driving range, CO_2 emission, the warranty period of hybrid battery, source of energy, government incentives and the sound of hybrid engine including the HCs running costs. All attributes are depicted in three levels except the running costs. We used four levels for the running costs attribute. The details of the attributes and their levels are shown in Table 1.

The SPSS orthogonal software was used to develop the orthogonal main effects design (OMEP). To form a choice card, the study employed the random pairing choice. An example of choice card is shown in Figure 1.

Empirical Results

The respondents in the study were required to answer four choice cards. A total of 242 respondents were interviewed using a face-to-face survey questionnaire but only 197 were usable for the analysis. To investigate the effect of knowledge types on HCs choices we regress three CL estimation models. The first regression model is a combination of respondents either acquired subjective or objective knowledge, while the remaining two were subsample whether the respondents have subjective knowledge or objective knowledge. The number of respondents for the former and latter group were 145 and 52, respectively. The utility function V_{in} is shown in (4).

$$V_{in} = \beta_1.\text{Dis1} + \beta_2.\text{Dis2} + \beta_3.CO_2 1 + \beta_4.CO_2 2 + \beta_5.\text{BAT1} + \beta_6.\text{BAT2} + \beta_7.\text{ENE1} + \beta_8.\text{ENE2} + \beta_9.\text{INS1} + \beta_{10}.\text{INS2} + \beta_{11}.\text{SOUND1} + \beta_{12}.\text{SOUND2} + \beta_{13}.\text{COSTS}$$

(4)

Table 1: Attributes and their levels

Attribute	Variable Name	Level
Driving range (in km)		**20km/ litre**
	DIST1	25km/ litre
	DIST2	30km/ litre
CO_2 emission		**100gm/ km**
	$CO_2$1	90gm/ km
	$CO_2$2	80gm/ km
Battery warranty period		**8 years**
	BAT1	10 years
	BAT2	12 years
Source of energy		**Petrol**
	ENE1	Petrol and/or battery

	Hybrid Car A	Hybrid Car B	Hybrid Car C
Driving range(km)/litre	25km/litre	30km/litre	20km/litre
CO_2 Emission(g)/km	100g/km	90g/km	100g/km
Battery Warranty (years)	10 years	12 years	8 years

	ENE2	Battery
Government Incentives		**No excise duty**
	INS1	No excise duty and 10% insurance rebate
	INS2	No excise duty and 20% insurance rebate
The sound of hybrid engine		**Noisy**
	SOUND1	Mild
	SOUND2	Quiet
HCs Running Costs	COSTS	**RM 8,000**
		RM 9,500
		RM 11,000
		RM 12,500

The bold refers to the status quo

Table 2 shows the estimates of the three estimation models. The explanatory power for all models considered low with a range between 1 and 3 percent. The estimates in a combination model such as $CO_2$2, BAT1, BAT2, INS1, SOUND1 and SOUND2 are significant at least at the 10% significance level. The positive sign on the coefficients indicates that the respondents in the group are expecting a positive marginal utility if an additional improvement in the attribute happened.

Source(s) of Energy	Petrol and Battery	Battery	Petrol
Government Incentives	No excise tax + Insurance Rebate 20%	No excise tax + Insurance Rebate 10%	No excise tax
Engine Sounds	Noise	Normal	Quiet
Costs	RM9,500	RM12,500	RM8,000
My Choice			

Figure 1: An example of Choice Card

Table 2: Conditional Logit and Compensating Surplus (CS)

Variable	Pool Data		Subsample-With Knowledge		Subsample-No Knowledge	
	Coefficient	CS[a]	Coefficient	CS[a]	Coefficient	CS[a]
DIS1	-0.04796	-	-0.12214	-	0.87901***	2373.14
	(0.12390)		(0.14257)		(0.38153)	
DIS2	-0.08832	-	-0.13489	-	0.83519**	2254.83
	(0.12860)		(0.14943)		(0.39668)	
$CO_2$1	0.17512	-	0.28553*	1823.31	-0.04194	-
	(0.14181)		(0.16499)		(0.41338)	
$CO_2$2	0.32493***	2037.18	0.38576***	2463.35	0.21842	-
	(0.11859)		(0.13853)		(0.35024)	
BAT1	0.28567**	1791.03	0.36619**	2338.37	0.41460	-
	(0.12842)		(0.14950)		(0.39158)	
BAT2	0.37967***	2380.38	0.50362***	3215.96	0.16003	-
	(0.13998)		(0.16497)		(0.38787)	
EN1	0.06277	-	0.02668	-	-0.19421	-
	(0.14061)		(0.16368)		(0.41534)	
EN2	0.04815	-	0.05471	-	-0.25095	-
	(0.13372)		(0.15635)		(0.38502)	
INS1	0.25018*	1568.53	0.25941	-	-0.10785	-
	(0.14243)		(0.16111)		(0.45991)	
INS2	0.05138	-	0.01208	-	-0.08803	-
	(0.14621)		(0.17050)		(0.51284)	
SOUND1	-0.23801*	-	-0.21966	-	-0.29874	-
	(0.12316)	1492.23	(0.14339)		(0.36370)	
SOUND2	-0.31560**	-	-0.39241***	-2505.81	-0.17453	-
	(0.12475)	1978.68	(0.14618)		(0.38547)	
Pri	-	-	-0.0001566**	-	-0.0003704**	-
	0.0001595***		(0.00649)		(0.01814)	
	(0.00563)					
LL (0)	-850.05559		-621.52178		-111.76404	
R-squared	0.013		0.02		0.04	

***significant at 1%, ** significant at 5%, and *significant at 10%; std. errors are in brackets

[a] CS is calculated in Ringgit Malaysia (RM)

For illustration purpose, see the estimate of $CO_2$2 0.32493. The value indicates the respondents' marginal utility will be increased by 0.32493 if the CO_2 emission were reduced from 100gm/ km to 80gram/ km. It is noteworthy that the sign of SOUND coefficient at both levels are negative. This indicates an improvement in the sound of hybrid engine will decrease the marginal utility of the respondents. In other words, they are not preferred quiet hybrid engine as compared to what they have at this moment.

The ultimate reason for including the coefficient of costs in the CL model is to calculate Compensating Surplus (CS). The formula for calculating the CS is $\frac{\beta_{attribute}}{\beta_{costs}}$. The coefficient of COSTS must be significant otherwise the CS value is meaningless (Hensher, Rose, & Greene, 2005). The CS results in Table 2 for the combined respondents show that the highest value that the respondents are willing to pay is BAT2 (RM2380). This followed with attribute CO_2 at higher level (RM2037) and BAT1 (RM1791). For the SOUND attribute at both level, the respondents are expecting the price of hybrid cars will be reduced by RM1492 if their engine sound becomes mild and RM1979 for quiet sound.

We employed Likelihood Ratio (LR) test for investigating whether the preferences of respondents who has subjective knowledge on hybrid is different with the ones with objective knowledge. The result shows that the calculated Chi Square value (233.539) exceeded the table Chi Square value (22.362). Hence, we concluded that the preferences between these two groups are significantly different.

As shown in Table 2, types of knowledge that respondents have on HCs has their impact of the cars' attributes preferences. The results show that for those who have objective knowledge on HCs prefer in driving range where the coefficients of the attribute are significant at least at the 5% level. The driving range is the only attribute significant for this subsample respondents. However, the coefficient value for medium level is higher than the higher level. That means the

respondents in the group are more preferred the driving distance of 25km/ litre than the 30km/ litre. Perhaps this happened due to their knowledge limitation on the HCs. In terms of CS, the respondents are willing to pay up to RM2373 for an additional mileage from 20km/ litre to 25km/ litre in driving range.

Overall, the results for respondents who has subjective knowledge on HCs are similar to the results of combined respondents except for the attributes $CO_2$1, INS1 and SOUND1. For instance, the coefficient for attribute $CO_2$1 which is not significant in the combination data becomes significant in this subsample. The opposite scenario happened for the coefficients INS1 and SOUND1 where the coefficients are significant in pool data but not in the subsample analysis. All these three coefficients, however, are significant only at the 10 percent level. In terms of CS, those who have subjective knowledge on HCs are willing to pay more if compared to the CS of combined respondents. For instance, the CS value for warranty period of hybrid battery. The results in Table 2 show that the respondents with the knowledge are willing to pay up to RM3215 if the battery warranty is extended from 8 years to 12 years. But for the combined respondents the CS value for similar improvement in the attribute is RM2380.

Conclusion and Policy Implications

This paper has focused on the heterogeneity in consumer preferences on hybrid cars. We investigated whether respondents who have subjective knowledge on HCs have different preference with those who have objective knowledge. This paper applied Choice Modelling (CM) technique. In investigating the issue, we have regressed three Conditional Logit models including a combination of respondents with objective and subjective knowledge, subsample of respondents with subjective knowledge and subsample of respondents with objective knowledge. The findings from the CL models indicate that HCs preferences for respondents who have subjective knowledge differ with their counterparts. The findings also informed us that

knowledge is an important factor for investigating consumers' preferences on HCs. These findings suggest that a government needs to enhance consumers' subjective knowledge before asking them to state their preferences on HCs. Such preferences information is important for the government for drafting, proposing or implementing policy on the HCs. The findings also suggest that in promoting HCs the Malaysian government should not only focus on conventional approaches such as subsidizing the production or tax exemption but the marketing innovation. The innovation in this context is to cut the transaction cost for consumer in acquiring knowledge.

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